

Claims

What is claimed is:

1. An apparatus for radially expanding and plastically deforming an expandable tubular member, comprising:
 - a support member;
 - a cutting device for cutting the tubular member coupled to the support member;
 - a gripping device for gripping the tubular member coupled to the support member;
 - a sealing device for sealing an interface with the tubular member coupled to the support member;
 - a locking device for locking the position of the tubular member relative to the support member;
 - a first adjustable expansion device for radially expanding and plastically deforming the tubular member coupled to the support member;
 - a second adjustable expansion device for radially expanding and plastically deforming the tubular member coupled to the support member;
 - a packer coupled to the support member; and
 - an actuator for displacing one or more of the sealing assembly, first and second adjustable expansion devices, and packer relative to the support member.
2. An apparatus for cutting a tubular member, comprising:
 - a support member; and
 - a plurality of movable cutting elements coupled to the support member.
3. An actuator, comprising:
 - a tubular housing;
 - a tubular piston rod movably coupled to and at least partially positioned within the housing;
 - a plurality of annular piston chambers defined by the tubular housing and the tubular piston rod; and
 - a plurality of tubular pistons coupled to the tubular piston rod, each tubular piston movably positioned within a corresponding annular piston chamber.
4. An apparatus for controlling a packer, comprising:
 - a tubular support member;

one or more drag blocks releasably coupled to the tubular support member; and a tubular stinger coupled to the tubular support member for engaging the packer.

5. A packer comprising:
 - a support member defining a passage;
 - a shoe comprising a float valve coupled to an end of the support member;
 - one or more compressible packer elements movably coupled to the support member;
 - and
 - a sliding sleeve valve movably positioned within the passage of the support member.
6. A method of radially expanding and plastically deforming an expandable tubular member within a borehole having a preexisting wellbore casing, comprising:
 - positioning the tubular member within the borehole in overlapping relation to the wellbore casing;
 - radially expanding and plastically deforming a portion of the tubular member to form a bell section; and
 - radially expanding and plastically deforming a portion of the tubular member above the bell section comprising a portion of the tubular member that overlaps with the wellbore casing;
 - wherein the inside diameter of the bell section is greater than the inside diameter of the radially expanded and plastically deformed portion of the tubular member above the bell section.
7. A method for forming a mono diameter wellbore casing, comprising:
 - positioning an adjustable expansion device within a first expandable tubular member;
 - supporting the first expandable tubular member and the adjustable expansion device within a borehole;
 - lowering the adjustable expansion device out of the first expandable tubular member;
 - increasing the outside dimension of the adjustable expansion device;
 - displacing the adjustable expansion device upwardly relative to the first expandable tubular member m times to radially expand and plastically deform m portions of the first expandable tubular member within the borehole;
 - positioning the adjustable expansion device within a second expandable tubular member;

supporting the second expandable tubular member and the adjustable expansion device within the borehole in overlapping relation to the first expandable tubular member;

lowering the adjustable expansion device out of the second expandable tubular member; increasing the outside dimension of the adjustable expansion device; and displacing the adjustable expansion device upwardly relative to the second expandable tubular member n times to radially expand and plastically deform n portions of the second expandable tubular member within the borehole.

8. A method for radially expanding and plastically deforming an expandable tubular member within a borehole, comprising:

positioning an adjustable expansion device within the expandable tubular member; supporting the expandable tubular member and the adjustable expansion device within the borehole;

lowering the adjustable expansion device out of the expandable tubular member; increasing the outside dimension of the adjustable expansion device; displacing the adjustable expansion mandrel upwardly relative to the expandable tubular member n times to radially expand and plastically deform n portions of the expandable tubular member within the borehole; and pressurizing an interior region of the expandable tubular member above the adjustable expansion device during the radial expansion and plastic deformation of the expandable tubular member within the borehole.

9. A method for forming a mono diameter wellbore casing, comprising:

positioning an adjustable expansion device within a first expandable tubular member; supporting the first expandable tubular member and the adjustable expansion device within a borehole;

lowering the adjustable expansion device out of the first expandable tubular member; increasing the outside dimension of the adjustable expansion device; displacing the adjustable expansion device upwardly relative to the first expandable tubular member m times to radially expand and plastically deform m portions of the first expandable tubular member within the borehole; pressurizing an interior region of the first expandable tubular member above the adjustable expansion device during the radial expansion and plastic deformation

of the first expandable tubular member within the borehole;
positioning the adjustable expansion mandrel within a second expandable tubular member;
supporting the second expandable tubular member and the adjustable expansion mandrel within the borehole in overlapping relation to the first expandable tubular member;
lowering the adjustable expansion mandrel out of the second expandable tubular member;
increasing the outside dimension of the adjustable expansion mandrel;
displacing the adjustable expansion mandrel upwardly relative to the second expandable tubular member n times to radially expand and plastically deform n portions of the second expandable tubular member within the borehole; and
pressurizing an interior region of the second expandable tubular member above the adjustable expansion mandrel during the radial expansion and plastic deformation of the second expandable tubular member within the borehole.

10. A method for radially expanding and plastically deforming an expandable tubular member within a borehole, comprising:
supporting the expandable tubular member, an hydraulic actuator, and an adjustable expansion device within the borehole;
increasing the size of the adjustable expansion device; and
displacing the adjustable expansion device upwardly relative to the expandable tubular member using the hydraulic actuator to radially expand and plastically deform a portion of the expandable tubular member.
11. A method for forming a mono diameter wellbore casing within a borehole that includes a preexisting wellbore casing, comprising:
supporting the expandable tubular member, an hydraulic actuator, and an adjustable expansion device within the borehole;
increasing the size of the adjustable expansion device;
displacing the adjustable expansion device upwardly relative to the expandable tubular member using the hydraulic actuator to radially expand and plastically deform a portion of the expandable tubular member; and
displacing the adjustable expansion device upwardly relative to the expandable tubular

member to radially expand and plastically deform the remaining portion of the expandable tubular member and a portion of the preexisting wellbore casing that overlaps with an end of the remaining portion of the expandable tubular member.

12. A method of radially expanding and plastically deforming a tubular member, comprising:
positioning the tubular member within a preexisting structure;
radially expanding and plastically deforming a lower portion of the tubular member to form a bell section; and
radially expanding and plastically deforming a portion of the tubular member above the bell section.
13. A method of radially expanding and plastically deforming a tubular member, comprising:
applying internal pressure simultaneously to the inside surface of the tubular member at a plurality of discrete location separated from one another.
14. A system for radially expanding and plastically deforming an expandable tubular member within a borehole having a preexisting wellbore casing, comprising:
means for positioning the tubular member within the borehole in overlapping relation to the wellbore casing;
means for radially expanding and plastically deforming a portion of the tubular member to form a bell section; and
means for radially expanding and plastically deforming a portion of the tubular member above the bell section comprising a portion of the tubular member that overlaps with the wellbore casing;
wherein the inside diameter of the bell section is greater than the inside diameter of the radially expanded and plastically deformed portion of the tubular member above the bell section.
15. A system for forming a mono diameter wellbore casing, comprising:
means for positioning an adjustable expansion device within a first expandable tubular member;
means for supporting the first expandable tubular member and the adjustable expansion device within a borehole;
~~means for lowering the adjustable expansion device out of the first expandable tubular~~

member;

means for increasing the outside dimension of the adjustable expansion device;

means for displacing the adjustable expansion device upwardly relative to the first expandable tubular member m times to radially expand and plastically deform m portions of the first expandable tubular member within the borehole;

means for positioning the adjustable expansion device within a second expandable tubular member;

means for supporting the second expandable tubular member and the adjustable expansion device within the borehole in overlapping relation to the first expandable tubular member;

means for lowering the adjustable expansion device out of the second expandable tubular member;

means for increasing the outside dimension of the adjustable expansion device; and

means for displacing the adjustable expansion device upwardly relative to the second expandable tubular member n times to radially expand and plastically deform n portions of the second expandable tubular member within the borehole.

16. A system for radially expanding and plastically deforming an expandable tubular member within a borehole, comprising:

means for positioning an adjustable expansion device within the expandable tubular member;

means for supporting the expandable tubular member and the adjustable expansion device within the borehole;

means for lowering the adjustable expansion device out of the expandable tubular member;

means for increasing the outside dimension of the adjustable expansion device;

means for displacing the adjustable expansion mandrel upwardly relative to the expandable tubular member n times to radially expand and plastically deform n portions of the expandable tubular member within the borehole; and

means for pressurizing an interior region of the expandable tubular member above the adjustable expansion device during the radial expansion and plastic deformation of the expandable tubular member within the borehole.

17. A system for forming a mono diameter wellbore casing, comprising:

means for positioning an adjustable expansion device within a first expandable tubular member;

means for supporting the first expandable tubular member and the adjustable expansion device within a borehole;

means for lowering the adjustable expansion device out of the first expandable tubular member;

means for increasing the outside dimension of the adjustable expansion device;

means for displacing the adjustable expansion device upwardly relative to the first expandable tubular member m times to radially expand and plastically deform m portions of the first expandable tubular member within the borehole;

means for pressurizing an interior region of the first expandable tubular member above the adjustable expansion device during the radial expansion and plastic deformation of the first expandable tubular member within the borehole;

means for positioning the adjustable expansion mandrel within a second expandable tubular member;

means for supporting the second expandable tubular member and the adjustable expansion mandrel within the borehole in overlapping relation to the first expandable tubular member;

means for lowering the adjustable expansion mandrel out of the second expandable tubular member;

means for increasing the outside dimension of the adjustable expansion mandrel;

means for displacing the adjustable expansion mandrel upwardly relative to the second expandable tubular member n times to radially expand and plastically deform n portions of the second expandable tubular member within the borehole; and

means for pressurizing an interior region of the second expandable tubular member above the adjustable expansion mandrel during the radial expansion and plastic deformation of the second expandable tubular member within the borehole.

18. A system for radially expanding and plastically deforming an expandable tubular member within a borehole, comprising:

means for supporting the expandable tubular member, an hydraulic actuator, and an adjustable expansion device within the borehole;

means for increasing the size of the adjustable expansion device; and

means for displacing the adjustable expansion device upwardly relative to the

expandable tubular member using the hydraulic actuator to radially expand and plastically deform a portion of the expandable tubular member.

19. A system for forming a mono diameter wellbore casing within a borehole that includes a preexisting wellbore casing, comprising:
 - means for supporting the expandable tubular member, an hydraulic actuator, and an adjustable expansion device within the borehole;
 - means for increasing the size of the adjustable expansion device;
 - means for displacing the adjustable expansion device upwardly relative to the expandable tubular member using the hydraulic actuator to radially expand and plastically deform a portion of the expandable tubular member; and
 - means for displacing the adjustable expansion device upwardly relative to the expandable tubular member to radially expand and plastically deform the remaining portion of the expandable tubular member and a portion of the preexisting wellbore casing that overlaps with an end of the remaining portion of the expandable tubular member.
20. A system for radially expanding and plastically deforming a tubular member, comprising:
 - means for positioning the tubular member within a preexisting structure;
 - means for radially expanding and plastically deforming a lower portion of the tubular member to form a bell section; and
 - means for radially expanding and plastically deforming a portion of the tubular member above the bell section.
21. A system of radially expanding and plastically deforming a tubular member, comprising:
 - a support member; and
 - means for applying internal pressure simultaneously to the inside surface of the tubular member at a plurality of discrete location separated from one another coupled to the support member.
22. A method of cutting a tubular member, comprising:
 - positioning a plurality of cutting elements within the tubular member; and
 - bringing the cutting elements into engagement with the tubular member.

23. A method of injecting a hardenable fluidic sealing material into an annulus between a tubular member and a preexisting structure, comprising:
 - positioning the tubular member into the preexisting structure;
 - sealing off an end of the tubular member;
 - operating a valve within the end of the tubular member; and
 - injecting a hardenable fluidic sealing material through the valve into the annulus between the tubular member and the preexisting structure.
24. A system for cutting a tubular member, comprising:
 - means for positioning a plurality of cutting elements within the tubular member; and
 - means for bringing the cutting elements into engagement with the tubular member.
25. An actuator system, comprising:
 - a support member; and
 - means for pressurizing a plurality of pressure chambers coupled to the support member.
26. A system for injecting a hardenable fluidic sealing material into an annulus between a tubular member and a preexisting structure, comprising:
 - means for positioning the tubular member into the preexisting structure;
 - means for sealing off an end of the tubular member;
 - means for operating a valve within the end of the tubular member; and
 - means for injecting a hardenable fluidic sealing material through the valve into the annulus between the tubular member and the preexisting structure.
27. A packer module for a packer assembly, comprising:
 - a support member;
 - one or more compressible packer sealing elements coupled to the support member;
 - one or more packer compressing elements movably coupled to the support member for compressing the compressible packer sealing elements; and
 - one or more engagement elements movably coupled to the support member for engaging the interior surface of a tubular member;
 - wherein each of the packer compressing elements comprise a plurality of circumferentially spaced apart packer compressing elements; and

wherein each of the engagement elements comprise a plurality of circumferentially spaced apart packer compressing elements.

28. A method of gripping a tubular member, comprising:
positioning a plurality of spaced apart gripping elements within the tubular member; and
bringing the gripping elements into engagement with the tubular member comprising:
displacing the gripping elements in an axial direction; and
displacing the gripping elements in a radial direction; and
biasing the gripping elements against engagement with the tubular member.
29. A system for injecting a hardenable fluidic sealing material into an annulus between a tubular member and a preexisting structure, comprising:
means for positioning the tubular member into the preexisting structure;
means for sealing off an end of the tubular member;
means for operating a valve within the end of the tubular member; and
means for injecting a hardenable fluidic sealing material through the valve into the annulus between the tubular member and the preexisting structure.
30. A system for gripping a tubular member, comprising:
means for positioning a plurality of spaced apart gripping elements within the tubular member; and
means for bringing the gripping elements into engagement with the tubular member comprising:
means for displacing the gripping elements in an axial direction; and
means for displacing the gripping elements in a radial direction; and
means for biasing the gripping elements against engagement with the tubular member.
31. A method of engaging a tubular member, comprising:
positioning a plurality of elements within the tubular member;
bringing the elements into axial alignment;
translating the elements;
pivoting the elements;
rotating the elements about a common axis;
bringing the elements into engagement with the tubular member; and

preventing the elements from coming into engagement with the tubular member if the inside diameter of the tubular member is less than a predetermined value; wherein the elements comprise:

- a first group of elements; and
- a second group of elements;

wherein the first group of elements are interleaved with the second group of elements.

32. A system for engaging a tubular member, comprising:

- means for positioning a plurality of elements within the tubular member;
- means for bringing the elements into axial alignment;
- means for translating the elements;
- means for pivoting the elements;
- means for rotating the elements about a common axis;
- means for bringing the elements into engagement with the tubular member; and
- means for preventing the elements from coming into engagement with the tubular member if the inside diameter of the tubular member is less than a predetermined value;

wherein the elements comprise:

- a first group of elements; and
- a second group of elements;

wherein the first group of elements are interleaved with the second group of elements.